Unit 2, Lesson 03: Cycloalkanes and Aromatics; Physical Properties of Hydrocarbons

Answers to Homework:

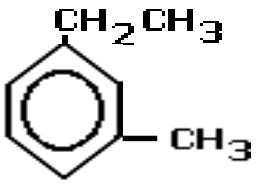
1. Read pages 18 – 19.
2. Read pages 22 - 24 (Start at Physical Properties and Forces Between Molecules)

3. Page 16, Q 5b, 5f: Answers on page 55 are correct

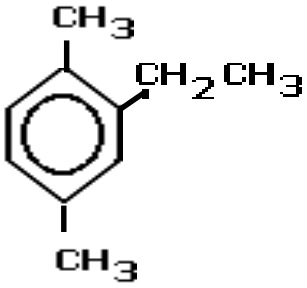
4. Page 19, Q 10: Answer on page 55 is correct

Page 19, Q 11

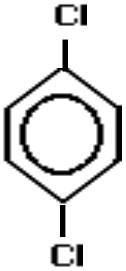
a) 1-ethyl-3-methylbenzene



11b) 2-ethyl-1,4-dimethylbenzene

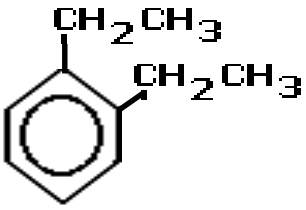


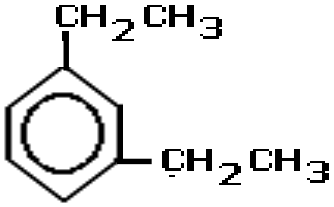
11c) para-dichlorobenzene

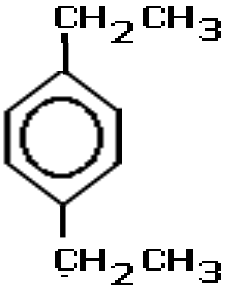


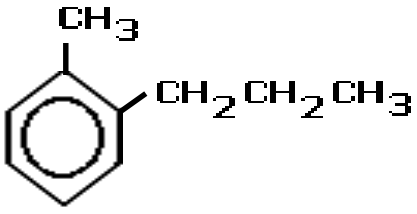
Page 19, Q 12: answer on page 55 is correct

Page 19, Q 13:





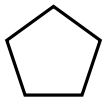




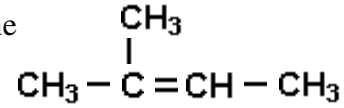
Any combination of 2 side chains totalling 4 carbon groups are correct answers. Each time a side chain is added to a benzene ring, it replaces a hydrogen atom on the benzene ring, so only 2 side chains can be added.

5. Page 20, Q 1: answers on page 55 in Section review 1.2 are correct

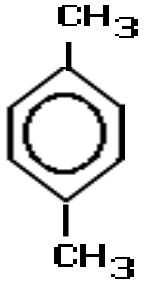
Page 20, Q 2:

2a) cyclopentane  (should be drawn with 5 CH_2 groups, but I'm too lazy)

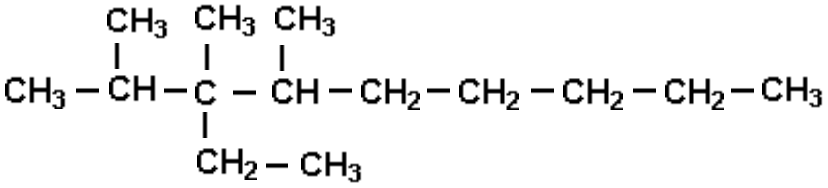
2b) 2-methyl-2-butene



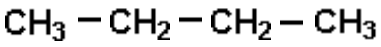
2c) 1,4-dimethylbenzene



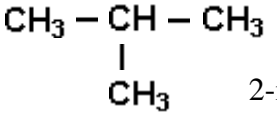
2d) 3-ethyl-2,3,4-trimethylnonane



Page 20, Q3. There are only two structural isomers with the molecular formula C_4H_{10} :



butane



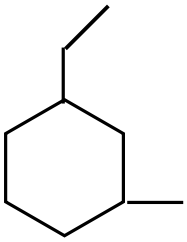
2-methylpropane

Page 20, Q4:

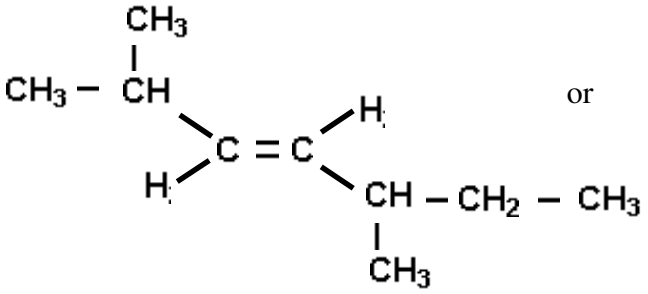
a) pentane

b) 2-methylpropane

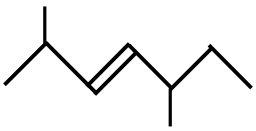
c) 1-ethyl-3-methylcyclohexane



d) trans-2,5-dimethyl-3-heptene



or



Page 20, Q5: see names of structures on page 55 in section review 1.2

Page 20, Q7: see names of structures on page 55 in section review 1.2

1. Summarize the section in green- we will be discussing H-bonding, molecular polarity and dispersion forces for every type of organic compound.

   Make your own notes please.

2. Do the "Thoughtlab" on page 24 (Q1 should read "draw **the** molecules…", NOT "draw **three** molecules…"

Page 24, Q2: Hydrogen bonding can occur between molecules of 1-propanol and between molecules of 1-heptanol. These are the only molecules that contain O – H bonds which will allow hydrogen bonding.

Page 24, Q3: Only 1-propanol and 1-heptanol are polar molecules. They are polar because they are asymmetrical around the carbon atoms that have the –OH group.

Propane and heptane are non-polar molecules. This is because they contain only non-polar bonds and have no lone pairs on any of the carbon atoms.

Page 24, Q4:

a) Heptane will have stronger dispersion forces than propane. This is because it is the longest, straightest non-polar molecule. The longer the carbon chain, the greater the opportunity for dispersion forces to act between the molecules.
b) Heptane will have a higher boiling point than propane. This is because it has stronger dispersion forces between molecules so it will take more energy to separate the molecules from one another to allow boiling.

Page 24, Q5:

a) 1-propanol is more polar than 1-heptanol. This is because they have the same polar –OH group, but propanol has a shorter alkyl chain, so the non-polar part of the molecule is much shorter.
b) 1-propanol is more polar than 1-heptanol. This is because they have the same polar –OH group, but propanol has a shorter alkyl chain, so the non-polar part of the molecule is much shorter. The shorter non-polar region of the molecule means that it will be more soluble in water (which is a polar solvent).

Page 24, Analysis questions:

1a) A polar compound is more soluble in water than a non-polar compound, because water is a polar solvent.

1b) A compound that forms hydrogen bonds with water will be more soluble in water than a compound that does not form hydrogen bonds. The hydrogen bonds strengthen the inter-molecular attraction between the compound and water molecules, making it more soluble.

1c) $CH_3CH_2CH_2OH$ is more soluble in water than $CH_3CH_2CH_2CH_3CH_2OH$. This is because the first molecule (1-propanol) has a shorter non-polar region so it will dissolve better in water.

2a) Polar compounds have stronger attractions between molecules than non-polar compounds. Polar compounds have dipole-dipole and dispersion forces of attraction between molecules, while non-polar molecules have only dispersion forces. Dipole-dipole forces are much stronger than dispersion forces.

2b) Polar compounds that contain O – H or N – H bonds are capable of hydrogen bonding, which is a very strong form of dipole-dipole attractions. This will strengthen the forces of attraction between molecules, compared to molecules that do not have O – H or N – H bonds and can not hydrogen bond.

3a) Polar compounds that contain O – H or N – H bonds are capable of hydrogen bonding, which is a very strong form of dipole-dipole attractions. This will strengthen the forces of attraction between molecules, compared to molecules that do not have O – H or N – H bonds and can not hydrogen bond. The stronger inter-molecular attraction will require more energy to separate the molecules, which will result in a higher boiling point.

3b) $CH_3CH_2CH_2OH$ will have a lower melting point than $CH_3CH_2CH_2CH_3CH_2OH$. This is because the first molecule (1-propanol) has a shorter non-polar region so it will have weaker dispersion forces between molecules. Both groups have the same –OH group on the end of the molecule, so it is only the length of the non-polar region that determine their differences in boiling point.

4a) Ammonia is a polar molecule, while methane is non-polar. For this reason, ammonia will dissolve better in water, which is also polar. Ammonia is also capable of hydrogen bonding, so it will have a higher boiling point than methane, which has only dispersion forces between its molecules.

4b) Pentanol is a polar molecule, while pentane is non-polar. For this reason, pentanol will dissolve better in water, which is also polar. pentanol is also capable of hydrogen bonding, so it will have a higher boiling point than pentane, which has only dispersion forces between its molecules. (Both molecules have the same length of carbon chain, so their dispersion forces are essentially equal.)